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of one is the suversed sine of the other"—1736 tr. *Du Halde's Hist. China,* III, 70," "In casting up Accounts they [the Chinese] make use of an Instrument called Souan pan." [The term is derived from the Chinese and means, literally, reckoning board.]

ARTICLES IN CURRENT PERIODICALS.

American Journal of Mathematics, volume 41, no. 1, January, 1919: "Groups generated by two operators whose relative transforms are equal to each other" by G. A. Miller, 1–4; "A classification of general (2, 3) point correspondences between two planes" by T. R. Hollcroft, 5–24; "The classification of plane involutions of order (3)" by Anna M. Howe, 25–48; "On surfaces containing a system of cubics that do not constitute a pencil" by C. H. Sisam, 49–59; "An isoperimetric problem with variable end-points" by A. S. Merrill, 60–78—No. 2, April: "Asymptotic satellites near the straight-line equilibrium points in the problem of three bodies" by D. Buchanan, 79–110; "Concerning the invariant theory of involutions of conics" by W. Sensenig, 111–122; "Note on seminvariants of partial differential equations" by A. L. Nelson, 123–132; "On a method for determining the non-stationary state of heat in an ellipsoid" by B. Datta, 133–142; "Nilpotent algebras generated by two units, i and j, such that i^2 is not an independent unit" by G. W. Smith, 143–164.

Annaes Scientificos da Academia Polytechnica do Porto, volume 11, 1916, no. 1: "Sur différents procédés d'approximation" by A. Aubry, 5–35; "Timorenses de Okussi e Ambeno" by A. A. Mendes Corrêa, 36–51; "Palavras proferidas na sessão do lançamento da primeira pedra da Escola de Pharmacia da Universidade do Porto no dia 1 de fevereiro de 1915," 52–57; "Quelques considérations sur les systèmes de formes linéaires" by Miss Velleda Gradara, 58–64—No. 2: "Recherches des involutions de genres zéro, bigenre un, appartenant à une surface de genres un" by L. Godeaux, 65–78; "Discurso proferido na sessão solemne do lançamento da primeira pedra a construcção do edificio da Escola de Farmacia do Porto" by N. F. Dias Salgueiro, 79–88; "Sôbre a correlação de certos índices mandibulares com o índice cefálico" by A. Pires de Lima, 89–103; "Essai d'une théorie analytique des lignes non-euclidiennes" (continuation) by G. Pirondini, 104–124; "L. Orlando" by G. T[eixeira], 125–126; Review by A. Freire de Andrade of L. F. Navarro's *Cristalografia geométrica elemental* (Madrid, 1915), 127–128—No. 3: "Sur l'aire d'un segment de courbe convexe" by E. Turrière, 129–140; "Essai d'une théorie analytique des lignes non-euclidiennes" (continued), by G. Pirondini, 141–146; "Notas sobre Vernier" by A. Cardoso Pereira, 147–154; Reviews by Gomes Teixeira, of Lecornu's *Cours de Mécaniques* (tomes 1–2, Paris, 1914–1915), Richardson and Landis's *Fundamental Conceptions of Modern Mathematics* (Chicago, 1916), Archibald's *Euclid's Book on Divisions of Figures* (Cambridge, 1915), and L. O. de Toledo's *Elementos de Aritmética Universal*, tome 2 (Madrid, 1916), 185–188; Review by Mendes Corrêa of Frassetto's *Diagnosi e valutazione numerica delle curve in antropometrica ed in biometrica* (Rome, 1916), 189–190—No. 4: "Extrait d'une lettre adressée à F. Gomes Teixeira" by E. Turrière, 193–195; "Sur les formes isoclines et le problème Diophantique qui en découle" by V. Souza Brandão, 196–223—Volume 12, No. 1, 1917: "Sur l'aire d'une courbe plane générale" by E. Turrière, 5–12; "Sur une intégrale définie dont l'élément est une exponentielle de degré 4" by P. Appell, 12–13; "Sobre a construcção das tangentes á cissoide obliqua que passam por um ponto exterior á curva" by F. Gomes Teixeira, 14–17; "L'équation tangentielle polaire des courbes de Cesàro" by L. Braude, 18–26; Reviews by G. T[eixeira] of Rey Pastor's *Fundamentos de la geometria proyetiva superior* (Madrid, 1916) and *Introduccion á la matematica superior* (Madrid, 1916), P. Burgatti's *Lezioni di meccanica razionale* (Bologna), Halphen's *Oeuvres* (tome 1, Paris, 1916), Bôcher's *Leçons sur les méthodes de Sturm* (Paris, 1917), and Boutroux's *Les principes de l'analyse mathématique* (Paris, 1914), 53–59—No. 2, 1918: "Los problemas de la mecánica" by E. Terradas, 94–125; "Rapport de M. Appell sur les travaux de M. F. Gomes Teixeira, 126–128, [Reprinted from *Comptes rendus de l'académie des sciences de Paris*, 1917, tome 165, p. 907; Quotation: "En dressant un catalogue raisonné de ces courbes, en donnant leur histoire dans un important ouvrage, M. F. Gomes Teixeira a rendu à la science un grand service, que la Commission propose de reconnaître en lui décernant le prix Binoux"]—No. 4, 1918: "Congresso de sevilha celebrado pela Associação Espanhola para o progresso das sciencias (6–11 de Maio de 1917)" by A. F. de Lacerda, "Sciências matemáticas" 201–204; "Sur la réprésentation géométrique de la torsion d'une courbe gauche," 218–224.

Annals of Mathematics, 2nd series, volume 20, no. 3, March, 1919: "On quaternions and their generalization and the history of the eight square theorem" by L. E. Dickson, 155–171; "Non-symmetric kernels of positive type" by Caroline E. Seely, 172–176; "Elementary properties of the Stieltjes integral" by H. E. Bray, 177–186; "A kinematical property of ruled surfaces" by J. K. Whittemore, 187–190; "Systems of linear inequalities" by L. L. Dines, 191–199; "On the shortest line between two points in non-Euclidean geometry" by T. H. Gronwall, 200–201; "The generalized gamma functions" by E. L. Post, 202–217; "On the most general plane closed point-set through which it is possible to pass a simple continuous arc" by R. L. Moore and J. R. Kline, 218–223; "Repeated integrals" by D. C. Gillespie, 224–228.

Athenaeum, London, 1919, April 18: "Dreams and facts," Part I by Bertrand Russell, 198–199; Review of Russell's *Introduction to Mathematical Philosophy* (London, 1919), 209–210—April 25: "Dreams and facts," Part II by B. Russell, 232–233.

Biometrika, Cambridge, Eng., volume 12, parts 1–2, November, 1918: "On the standard deviations of adjusted and interpolated values of an observed *polynomial function* and its constants and the guidance they give towards a proper choice of the distribution of observations" by Kirstine Smith, 1–85; "On the product-moments of various orders of the normal correlation surface of two variates" by K. Pearson and A. W. Young, 86–92; "The correlation coefficient of a polychroic table" by A. Ritchie-Scott, 93–133; "On a formula for the product-moment coefficient of any order of a normal frequency distribution in any number of variables" by L. Isserlis, 134–139; "On the mathematical expectation of the moments of frequency distributions" by A. A. Tchouproff, 140–169; "Sur les moments de la fonction de corrélation normale de *n* variables" by S. Bergström, 177–183; "Formulæ for determining the mean values of products of derivatives of mixed moment coefficients in two to eight variables in samples taken from a limited population" by L. Isserlis, 183–184.

Columbia University Quarterly, Volume 21, No. 2, April 1919: "The new wisdom" by C. J. Keyser, 118–124. [First paragraph: "It is evident that to meet the great demands of the coming time men and women must needs have a spiritual equipment—intelligence, imagination, sympathy, understanding—far surpassing that which has hitherto been deemed sufficient. For in the time to come men and women cannot be, as hitherto, mere dwellers in a province or mere members of a commonwealth, a state, or a nation. Whether they will or no, they are destined to be, in respect of their interests and obligations, citizens of the world. As competent citizens of the world they will have to be either competent leaders in the affairs of world citizenship or—what is not less important—competent judges of such leadership. Provincial wisdom, however precious or fine, cannot longer suffice. What is demanded is a certain large intelligence—a certain wisdom, as we may call it—about the world."]

Education, Boston, volume 39, no. 8, April, 1919: "A review book in mathematics" by R. R. Goff, 471–472.

Journal of Education, London, volume 51, February 1, 1919: "Mathematical problem papers" by C. Davison, 90–91; "Mathematical Association," 130.

Journal of the Washington Academy of Sciences, volume 9, no. 3, February 4, 1919: "A contribution to quantitative epidemiology" by A. J. Lotka, 73–77.

Matematisk Tidsskrift, Copenhagen, 1919, no. 1, February, *A*: "H. G. Zeuthen" (Portrait frontispiece), 1–2 [In honor of the 'Nestor of Danish mathematicians' whose eightieth birthday occurred on February 15, 1919. He was editor of the *Tidsskrift*, 1871–1889]; "Trekantens Vinkelsum" by J. Hjelmslev, 3–11; "De matematiske Opgaver ved Mellemskoleeksamen og Realeksamen. En kritisk Vurdering" by F. Friss-Petersen, 11–25; Review of *Tidsskrift för elementär Matematik, Fysik och Kemi*, Stockholm, 1917–18, 28–30; "Danske Eksamensopgaver," 30–37—*B*: "Til Tidsskriftets Laesere og Medarbejdere" by H. Bohr and T. Bonnesen, 1–2; "Det ojeblikkelige Drejningspunkt" by J. Hjelmslev, 2–14; "Om den Hadamard'ske 'Hulsætning'" by H. Bohr, 15–21; Review by T. B[onnesen] of Hjelmslev's Lærebog i Geometri til Brug ved den polytekniske Laereanstalt (København, 1918), 21–26; "Del af polyteknisk Eksamen, 1918- Deskriptiv Geometri" 26–28.

Mathematics Teacher, volume 11, no. 3, March, 1919: "Introductory course in mathematics" by D. E. Smith, 105–114; "First-year algebra, as developed in the academic high school, New Britain, Conn." by R. R. Goff, 115–117; "Indeterminate forms in trigonometry" by M. O. Tripp, 118–120; "The Courtis tests in arithmetic" by P. A. Boyer, 121–132; "Report of the committee to recommend a suitable program in mathematics for Junior High Schools" (H. D. Gaylord, chairman), 133–140; "Platform of the allied associations of public school teachers of Baltimore," 141; "Book Reviews" and "Notes and News" 142–144.

MIND, London, volume 43, July, 1918: "A general notation for the logic of relations" by C. D. Broad, 184–303; "A proof that any aggregate can be well-ordered" by P. E. B. Jourdain, 386–388. [First sentence: "That any aggregate can be well-ordered was stated by Georg Cantor, but he never succeeded in proving this theorem (*cf.* Cantor's *Contributions to the Founding of the Theory of Transfinite Numbers,* English translation, Chicago and London, 1915, pp. 60, 62–63, 66, 90, 109, 204–206)."]—No. 108, October: "On the relation between induction and probability (Part I)" by C. D. Broad, 389–404; "Note" by C. D. Broad, 508. [The "note": "I see, on looking through my paper in *Mind,* N.S., No. 107, that, although I at first speak of 'Whitehead and Russell' I later generally refer to pieces of notation contained in *Principia Mathematica* as 'Russell's.' I did not mean by this to ascribe them to Mr. Russell rather than to Dr. Whitehead. I have no idea which of the authors is responsible for any given part of the book, and I only used 'Russell' as an abbreviation for 'Russell and Whitehead.' I should be sorry indeed to appear unfair to Dr. Whitehead, and my only excuse is the extreme difficulty of putting a phrase like 'Russell and Whitehead' into the possessive in English. Perhaps Dr. Whitehead will provide me with a suitable notation for this purpose, and Mr. Russell will guarantee it to be 'ethically neutral.'"] Volume 44, January, 1919: "Notes on Zeno's arguments on motion" by P. E. B. Jourdain, 123–134; [Quotation: "The following notes have to do with two points. The first is to call attention to an argument used by Mr. R. A. P. Rogers; [In his paper 'On transfinite numbers, and some problems relating to the structure of actual space and time,' *Hermathena,* Vol. 15, 1910, pp. 397–415.] the second is to bring out the force of some remarks attributed to the shade of Zeno on pages 52–55 of the number of *Mind* for January, 1916,[1] and which do not seem to have been expressed clearly enough."] "Note on C. D. Broad's article in the July *Mind* by Bertrand Russell, 124. [The "note": "Mr. Broad's very interesting article . . . attributes to me (for what reason I cannot guess) a number of notations employed in *Principia Mathematica.* As far as my memory serves me, all these were invented by Dr. Whitehead, who, in fact, is responsible for most of the notation in that work. My original notation, before he came to my assistance, may be found in Peano's *Revue de Mathêmatiques,* vols. 7 and 8."]

NATIONAL REVIEW, London, volume 72, November, 1918: "The position of mathematics" by C. H. P. Mayo; [Reprinted in *Educational Review,* volume 57, March, 1919, pp. 194–204.].

NATURE, volume 103, March 13, 1919: Review by H. S. A. of Bryant's Galileo (London, 1918), 23; "Graphic methods in nautical astronomy" by A. Hutchinson, 25; [Quotations: "In the issue of *Nature* published on October 24 last (vol. 102, p. 155) there appeared an account of an ingenious chart devised by Mr. G. W. Littlehales, of the United States Hydrographic Department, for dealing rapidly with certain problems in nautical astronomy which involve the solution of a spherical triangle when the three sides, or the two sides and the included angle are known. The article is entitled 'A New Graphic Method in Nautical Astronomy,' but it would appear that the idea has been familiar in France for more than five-and-twenty years. The possibility of constructing a chart like that made by Mr. G. W. Littlehales was demonstrated by Maurice d'Ocagne so long ago as 1891 in his work *Nomographie: les calculs usuels effectués au moyen des abaques,* p. 84 and an abacus devised by him on these lines was described in W. Dyck's *Katalog mathematischer und mathematisch-physikalischer Modelle, Apparate und Instrumente,* published in 1892, p. 163. A figure of the chart can be found in a paper by d'Ocagne which appeared in *Journal de l'Ecole Polytechnique* (second series, 4th cahier, 1898, p. 224), and also in his *Traité de Nomographie,* 1899, p. 328. In a modified form the chart was employed by E. Collignon in 1898. (See his 'Note sur la détermination de l'heure du passage du soleil dans un plan vertical,' *Journal de l'Ecole Polytechnique, loc. cit.,* pp. 123–135. . . . The particular cases in the solution of spherical triangles it [the chart] is designed to deal with, frequently occur in the reduction of crystal measurements, and the use of the chart can be confidently recommended to crystallographers"]; "Professor E. C. Pickering," 28–29; "Roger Bacon (1214–94)" by C. Singer, 35–36; [Quotations: ". . . Roger Bacon, great as are his titles to remembrance, was neither the inventor nor introducer of the mariner's compass. . . . His work on this subject [optics] was a text-book for the next two centuries. He saw the importance of lenses and concave mirrors, and showed a remarkable grasp of mathematical optics. He described a system which is equivalent to a two-lens apparatus, and there is trustworthy evidence that he actually used a compound system of lenses equivalent to a telescope. . . . Astronomy was Bacon's perpetual interest. He spent the best part of twenty years in the construction of astronomical tables. His letter to the Pope, in favour of the correction of the calendar, though unsuccessful in his own days, was borrowed and reborrowed, and finally, at third-hand, produced the Gregorian correction. . . . Suggestions described by him include the automatic propulsion of vehicles and vessels. He records also the working out of a plan for a flying-machine. . . . His insistence on the supreme value of mathematics as a foundation for education recalls the attitude of Plato. It was an insistence that the method of thought was more important than its content.

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[1] "The flying arrow: an anachronism," pp. 42–45.

"Summed up, his legacy to thought may be regarded as accuracy of method, criticism of authority, and reliance on experiment—the pillars of modern science. The memory of such a man is surely worthy of national recognition."]—March 20: "Graphical methods in nautical astronomy" by H. B. Goodwin, 44; [Quotations: "As the author of the article in *Nature* of October 24, 1918, in which the diagram referred to by Dr. Hutchinson last week was first brought to the notice of your readers, may I be permitted to supplement the information as to previous efforts in the same direction? . . . M. d'Ocagne . . ., so far as appears at present, is clearly entitled to the credit claimed for him as first in the field. . . . The share of Mr. Littlehales, however, is marked by two features of interest:—(1) That he seems to have been the first to prepare and publish the diagram in a form that promises to be useful in the navigation of air and ocean, and (2) that the simplicity of treatment which deduced the principle and graduation of the chart directly from a formula of spherical trigonometry renders the theory of the matter intelligible to many nautical persons to whom the mysteries of 'Nomographie' are as a sealed book."] "A proof that any aggregate can be well-ordered" by P. E. B. Jourdain, 45; [Quotation: "All the critics of my method sketched or described in my two letters to *Nature* (vol. 101, pp. 84 and 304, 1918), in my two notes in *Comptes rendus* (vol. 166, pp. 520–523 and 984–986, 1918), in *Mind* for July, 1918, and in *Science Progress* for October, 1918, wish to see a certain particular case solved in detail. Although this case does not throw so much light on the problem as the equally simple method of dealing with the general case, which I happen to have discovered long before I applied it to special cases, I here give the treatment of the particular case referred to."] "Ludvig Sylow" by G. B. M[athews], 49.

NYT TIDSSKRIFT FOR MATEMATIK, volume 29, no. 3, January, 1919; *A*: "Några aritmetiska satser" by F. de Brun, 49–54; "Om tal som tallägen" by A. Arwin, 54–63; Review by N. E. Nørlund of A. F. Andersen, H. Bohr and J. Mollerup's *Nyere Undersøgelser over Integralregningen* (København, 1917), 64–68; Review by C. Hansen of E. Landau's *Einführung in die . . . Theorie der algebraischen Zahlen und der Ideale* (Leipzig, 1918), 68–73; "Studentereksamen i Maj 1918—For den matematisk-naturvidenskabelige Linie," 73–75; "Kronik," 77–79—*B*: "Einige Sätze über die ganzen, rationalen Funktionen" by T. Nagel, 53–62; "Skoleembedseksamen Juni 1918," 62–65; "Løninger" by N. Nielsen, 65–68.

PROCEEDINGS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES, Boston, Volume 54, No. 5, April, 1919: "A new geometrical model for the orthogonal projection of the cosines and sines of complex angles" by A. E. Kennelly, 369–378, 4 plates. [Geometrical constructions for producing plane-vector representations of $\cosh(\theta_1 + i\theta_2)$, $\sinh(\theta_1 + i\theta_2)$, and hence also $\cos(\theta + i\theta_2)$, $\sin(\theta_1 + i\theta_2)$, where $(\theta_1 + i\theta_2)$ is a complex argument, or a complex 'angle,' have been available for some time.[1] The constructions involve a rectangular hyperbola and an associated circle, in one and the same plane, which is the plane of the drawing. By making certain projections in this plane, followed by a rotation through a quadrant, a plane-vector is produced from the origin, corresponding to the complex hyperbolic or circular sine or cosine required. This process is open to the objection that it is somewhat forced and artificial, lacking the simple projective property that a sine or cosine of any real angle possesses in either circular or hyperbolic trigonometry.

More recently, a method of deriving the hyperbolic cosine or sine of a complex angle has been obtained,[2] which enabled the new three-dimensional model here described to be prepared. In this model, it will be seen that the cosine or sine of a complex angle, either hyperbolic or circular, can be produced, by two successive orthogonal projections on to the *XY* plane, one projection being made from a rectangular hyperbola, and the other projection being made from a particular circle definitely selected among a theoretically infinite number of such circles," concentric but not coplanar.]

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[1] "Two elementary constructions in hyperbolic trigonometry" by A. E. Kennelly, *Annals of Mathematics*, 2d series, Vol. 5, pp. 181–184, July, 1904; reproduced in A. E. Kennelly, *Tables of complex hyperbolic and circular functions*, Harvard University Press, 1914, pp. 165–168.

[2] A. E. Kennelly, *Artificial Electric Lines*, New York, 1917, pp. 120–121.

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, volume 5, no. 3, March, 1919: "Tables of the zonal spherical harmonic of the second kind $Q_1(z)$ and $Q_{11}(z)$" by A. G. Webster and W. Fisher, 79–82.—No. 4, April: "On the real folds of Abelian varieties" by S. Lefschetz, 103–106; "Covariants of binary modular groups" by O. E. Glenn, 107–110; "The general solution of the indeterminate equation: $Ax + By + Cz + \ldots = r$" by D. N. Lehmer, 111–114.

RECORD OF THE AMERICAN INSTITUTE OF ACTUARIES, Chicago, volume 7, June, 1918: Review by E. B. Escott of Running's *Empirical Formulæ* (New York, 1917), 55–60.

SCHOOL SCIENCE AND MATHEMATICS, volume 19, no. 4, April, 1919: "The case method of teaching mathematics" by G. A. Miller, 344–349; "On the relations of mathematics to commerce" by R. E. Moritz, 350–357; "Plane geometry for the ninth and tenth grades" by R. R. Goff, 357–358; "Notes on 'Bolshevik Multiplications,'" 359–361; "Problems and solutions," 372–376.

SCIENCE, new series, Volume 44, March 14,1 919: "Cross-section lines on blackboards and their illumination" by P. F. Gaehr, 265. ["Those who wish cross-section rulings on blackboards temporarily, thus leaving the board free for other work after the curve-plotting is finished, can do so by a simple device. On a sheet of white paper make a ruling of lines, 2 cm. apart, the whole grid 16 x 24 cm., and the lines not quite one mm. thick. Take a photograph of this, making the camera image the size of a lantern-slide. Mount the negative in a lantern, projecting the image on the blackboard. A lantern equipped with a 400-watt Mazda lamp will make the lines sufficiently visible for plotting even in a well-lighted room. The lines are erased by turning off the lamp."]—May 9: "Apropos of the proposed historical science section" [of the American Association for the Advancement of Science] by G. A. Miller, 447–448.

SCIENTIA, Bologna, volume 25, no. 3, March, 1919: "The place of Tycho Brahe in the history of astronomy" by J. L. E. Dreyer, 177–185, (French translation, supplément, 39–47); Review by P. E. B. Jourdain of Forsyth's *Theory of Functions of a complex variable,* Third Edition (Cambridge, 1918), 232–233.

SIGMA XI QUARTERLY, volume 6, no. 3, September, 1918: "In memoriam, Henry Shaler Williams (1847–1918)" (Portrait), 53–74. [Professor Williams was the founder of the Sigma Xi Society, and was elected the first president of the first chapter which was established at Cornell University in 1887.]

TEXAS MATHEMATICS TEACHERS' BULLETIN, volume 4, no. 2, February, 1919: "The State Teachers' Association" by J. W. Calhoun, 3; "A neglected opportunity" by H. Y. Benedict, 4–7; "The mathematics club in the high school" by C. E. LaMaster, 8–12; "Military applications of mathematics" by E. J. Oglesby, 13–15; "Factoring in first year algebra" by Mattie R. Watson, 16–18; "Geometry notebooks" by Mrs. Helen Bolton, 19–21; "Combining arithmetic and algebra in the high school" by L. V. Stockard, 22–24; "Can I interest all the pupils in geometry" by Mildred Watkins, 25–28; "The straight edge," 29.

TRANSACTIONS OF THE ROYAL SOCIETY OF CANADA, series 3, volume 12, December, 1918, section 3: "Rational plane anharmonic cubics" by A. M. Harding, 185–195.

AMERICAN DOCTORAL DISSERTATIONS.

L. C. Cox, *The finite groups of birational transformations of a net of cubics.* [Reprinted from *American Journal of Mathematics,* volume 39, 1917.] Pp. 59–74. (Cornell, 1915.)

J. V. De Porta, *Irrational involutions on algebraic curves.* [Reprinted from *American Journal of Mathematics,* volume 40, 1918.] Pp. 47–68. (Cornell, 1916.)

T. R. Hollcroft, *A classification of general* (2, 3) *point correspondences between two planes.* [Reprinted from *American Journal of Mathematics,* vol. 41, 1919.] Pp. 5–24. (Cornell, 1917.)

Anna M. Howe, *The classification of plane involutions of order* (3). [Reprinted from *American Journal of Mathematics,* volume 41, 1919.] Pp. 25–48. (Cornell, 1917.)

J. H. Minnick, *An investigation of certain abilities fundamental to the study of geometry.* Lancaster, Pa., New Era, 1918. Sm. 4to. 8 + 108 pages. (University of Pennsylvania, 1918.)